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THE UNIVERSITY OF ALBERTA

FOLLOW-UP EVALUATION OF STAT1 COMPUTER-ASSISTED INSTRUCTION PROGRAM AT THE UNIVERSITY OF ALBERTA

by

© FRANCES A. VARGO

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

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THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled Follow-up Evaluation of STAT1 Computer-assisted Instruction Program at University of Alberta submitted by Frances A. Vargo in partial fulfilment of the requirements for the degree of Master of Education.

Supervisor

Date. June 1, 1979

ABSTRACT

This study examined follow-up achievement performance and expressed attitudes toward STAT1, the University of Alberta computer-assisted instruction statistics program offered to students at the graduate level. An opinionaire and an achievement test designed by the author were administered to persons who completed the program in Winter Session 1976-77, Summer Session 1977, Spring Session 1978 and Summer Session 1978. Multiple matrix sampling procedures were used in developing the tests used to measure achievement.

Pearson correlations were calculated between all pairs of variables but only those variables dealing with expressed liking for learning statistics via CAI, and perceived usefulness of the material learned were examined in detail.

Results indicated that achievement levels for all groups were approximately equal and tended to be 15-20% below final course grades. Positive attitudes toward learning via CAI were maintained by all groups despite low reported use of the knowledge gained. The effects of such things as previous knowledge of statistics and apprehension about taking the program were discussed as influencing factors.

Recommendations for changes in STAT1 were made based on the comments offered by participants in the study and on the personal experience of the author.

ACKNOWLEDGEMENT

Of necessity, the completion of a project such as this requires the cooperation of many people, not the least of whom are subjects who participated in the study. To them, my heartfelt thanks. I would also like to thank my husband, Jim, for his constant praise and encouragement; my mother, Elsie Jordan, for her patient typing and retyping; and my committee members for their assistance at various stages. Finally, a special thank you to my supervisor, Tom Maguire, under whose guidance I discovered that conducting research can be a pleasant experience.

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Chapter 1

Introduction

Statement and Importance of the Problem

This study was undertaken for the purpose of evaluating, on a follow-up basis, a computer-assisted instruction program designed to teach statistics to graduate students in Educational Psychology at the University of Alberta. As such it comprises about 75-80% of the course hours in Educational Psychology 502 (EdPsy 502), the only other instruction being 16 hours of lecture time devoted to topics in research design.

The specific intent of the study was to provide information about the retrospective perceptions of students who had completed the program (known as STAT1) and to measure their performance in statistics six months to two years after completion of the program.

Upon completion of STAT1, all students responded to a questionnaire asking them to rate their agreement with statements about perceptions of STAT1. These statements included such factors as difficulty of the content, how enjoyable it was to learn via computer-assisted instruction, how interesting the material was perceived to be, and how useful the program was in helping the student to learn statistics.

For the purpose of this follow-up evaluation, attention was focussed on student perceptions as they related to two main areas: expressed liking for learning via computer-assisted instruction, and perceived usefulness of the material learned. Students were asked to complete a questionnaire containing some of the same items they had rated when they had just completed the program so that post and follow-up comparisons could be made. In addition, students were asked to rate

their initial apprehension about taking EdPsy 502, the reasons for this apprehension, and also to rate the amount and type of use they had made of the material learned. Students were invited to comment on the advantages and disadvantages of STAT1 and to make suggestions for additions or deletions which might improve the program.

The study was done for a number of reasons. First, the STAT1 program had been in use with few changes since 1976 so that enough time had elapsed to make a follow-up study feasible. Second, it is valuable for the course developers to know if a program is meeting the perceived needs of its consumers and fulfilling the objectives it was designed to satisfy. Finally, the computer-assisted instruction facility at the University of Alberta will be undergoing changes in 1980 when the computer equipment now in use is recalled by the manufacturer because it is considered obsolete. Decisions must be made about the nature and extent of service to be provided in the future not only by the facility itself but by the individual programs currently available. This study provides information about how well STAT1 is meeting the needs of the students and offers suggestions for changes to better meet those needs.

Limitations of the Study

No attempt was made to compare groups of students who had taken STAT1 with students who had learned statistics through classroom instruction only since the purpose of the study was not to defend computer-assisted instruction as a "better" means of instruction, but rather to

gather information for evaluating STAT1 in the context in which it was used. For the same reason, students who received both classroom instruction (in addition to research design) and STAT1 instruction were not included.

As an evaluation study, the scope of generalizability is limited to the particular program (STAT1) and the particular type of student involved (graduate students in the Faculty of Education). There is no evidence that findings may be generalized further to include other course contents, other levels of students or students in other universities.

Finally, the study was designed to evaluate the STAT1 program not the particular students who used it. Therefore, only group means were used to demonstrate achievement. Achievement test scores may give an indication as to how the group has maintained knowledge of statistics but may not be used for decision making regarding individuals. This is because the method of data collection involved the use of multiple matrix sampling (Shoemaker, 1970a) so that all subjects did not respond to the same items.

Definition of Terms

1. STAT1 - the computer-assisted instruction program to teach statistics to graduate students at the University of Alberta. It includes the instructional component as well as laboratory assignments associated with the program.

2. EdPsy 502 - the course name applied to a course in statistics offered to graduate students by the department of Educational Psychology at the University of Alberta. It includes STAT1 and 16 hours of classroom lectures on research design topics.

3. Computer-assisted instruction - a linear program operating in the tutorial mode, designed to replace classroom instruction of the specific content; in this case, statistics.

4. Attitude - "the bearing assumed by a person or body of persons indicative of feeling, opinion, etc." (Webster, 1960, p.63). Attitude shall be understood to refer to feelings or opinions held by students about STAT1 as a result of their experience with the program.

Chapter 2

Survey of the Literature

What is CAI?

The use of computers in education takes many forms, ranging from administrative functions such as time-tabling to teaching functions such as drill-and-practice routines and testing. A wide variety of these latter functions are included in the term Computer-Based Education (CBE). Unfortunately, when one tries to define or categorize more specifically, the proliferation of terminology in use is confusing. To demonstrate this point, the reader is directed to Salisbury (1971) who lists 21 terms found in the literature to be used interchangeably, although presumably not intended to mean precisely the same thing. Examples include such terms as computer-based instruction, computer-assisted instruction, computer-aided learning, and computer-managed instruction.

If one considers the student to be the main focus of attention in the field of education (a risky assumption, perhaps) then computer use may be defined in terms of student interaction. Two terms seem to lend clarity to the problem: 1) computer-managed instruction (CMI), and 2) computer-assisted instruction (CAI). Computer-managed instruction is generally agreed to include such functions as monitoring student progress on assignments, selection and assignment of appropriate learning experiences, instructional development, and record keeping (McLagan & Sandborgh, 1977; Smolinski, 1977). Student interaction is minimal and may consist solely of submitting responses to assignments into the computer for analysis and marking (Dixon & Judd, 1977). Hence CMI will not be considered further in this study.

Computer-assisted instruction (CAI) is defined as "...the use of the computer for direct instruction of students. Computer assisted instruction covers such uses as drill-and-practice, problem solving, simulation, and tutoring, but does not include computer-managed instruction or the teaching of computer science." (Kulik & Jaksa, 1977, p. 15). From the broad and general discriptions of CAI found in the literature, little is to be learned. Where explicit definitions are given, there seems to be agreement on these points:

1) instructional material is presented to the learner via the computer, and
2) interaction occurs between the student and the computer (Salisbury, 1971).

Having looked at this definition of CAI, it seems to make little difference if one substitutes the word "aided" for "assisted" or the word "teaching" for "instruction". There is, however, a difference between "learning" and "instruction". As Kearsley (1978) has pointed out, computer-assisted learning (CAL) focuses on the computer as a tool of the student, while computer-assisted instruction focuses on the computer as a tool of the instructor. CAL involves the issue of learner control which is not a concern of this particular work.

Within the concept of CAI, as defined above, there exist a number of instructional modes: drill-and-practice, simulation, tutorial, calculation, inquiry (similar but not identical to information retrieval), modelling, instructional games, and Socratic inquiry (McLagan & Sandborgh, 1977). These may be used singly or several combined into one CAI program. Those most commonly used, in terms of number of programs available, are drill-and-practice, tutor-

ial, problem solving, simulation, and a mixture of modes (Kearsley, 1976a).

With a definition of CAI and a list of the common instructional modes, it should be a relatively simple matter to evaluate reported studies employing CAI, but it is not. Very little effort has been made by various authors (e.g. Borman, 1970; Doty & Doty, 1964) to define and outline the programs under investigation. It is often not clear whether the program represents a whole course (i.e. the bulk of instruction in a subject) or only a part. The problem is such that Seidel et al (1978) have advocated dropping the term CAI in favor of project-specific terms which describe the ways in which the computer is being used. Some uniform definition and usage of terminology is certainly needed.

Why use CAI?

Having determined what we mean by CAI, it is now important to look at the reasons for using it as a method of instruction. The most comprehensive list of computer capabilities has been prepared by Ball (1971), as follows:

1) "...the power to record, manipulate, remember and respond to many persons individually and simultaneously." (p. 187).
2) adaptable to an unlimited number of variations
3) reacts only to the input of the student
4) displays infinite patience and lack of emotionality
5) gives and receives feedback immediately
6) identifies individual difficulties

7) allows progress at a self-determined rate, including test taking

8) frees the instructor to attend to the needs of the individual student with problems

9) requires less time to reach educational objectives

10) improves retention.

The first 8 capabilities are properties of most computer systems or are programmed into the instructional package. The last 2 will be discussed later. The listed capabilities are somewhat vague and as such allow equally for very good and very poor program design. The quality depends very much on the program author.

Hess and Tenezakis (1970) have taken a slightly different approach, looking at the computer as a socializing agent, and attempting to refute claims that learning via CAI is "dehumanizing". Their list of the properties of CAI includes:

1) capability for interaction

2) acts as a reinforcing agent

3) uses humanizing techniques such as addressing students by name

4) has intrinsic interest as a motivating and engaging feature - this is observed especially in studies involving children.

Finally, in a more recent attempt to dispel the belief that CAI is dehumanizing, Magidson (1977) has offered the following:

1) CAI lessons are not impersonal - stresses patience and immediate feedback.

2) CAI lessons are an extension of a human author - the computer does not create.

3) Drill and practice is no more dehumanizing than classroom drills.

4) CAI does not necessarily promote rote learning - it makes use of tutorial and simulation modes for higher level functioning.

5) CAI curriculum does not have to be fixed - changes are easily made.

6) Students report that CAI learning is enjoyable.

7) Some CAI systems include a personalized communication system (e.g., PLATO).

Rather than being a rigid, depersonalized instructor, the computer appears to be a faster, more efficient instructor with reinforcing and record-keeping capabilities beyond the reach of the most fastidious human teacher. It will be noted, however, that most of the computer capabilities listed are programming variables, and hence are only as good as the course designer. This substantial human element may make the difference between an interesting and effective program for learning and an ineffective one.

What does all this mean for the student? The implication has been that the student can be expected to learn at least as well as in a traditional instruction mode, to experience considerable time savings, and to express generally positive attitudes toward CAI as a mode of instruction (Jamison, Suppes & Wells, 1974; Petruk, 1978). The literature evaluating CAI as a means of instruction will be examined as it relates to each of these three considerations, i.e., effectiveness of CAI related to achievement, attitudes toward CAI, and time savings using CAI.

Effects of CAI on Achievement

As Kearsley (1977) has pointed out, it is not enough to say that CAI

is effective or ineffective as a teaching mode. Effectiveness needs to be examined in relation to many variables, such as learning styles, personality characteristics, and subject matter versus type of instruction. The typical report on the effectiveness of CAI involves a comparison of achievement scores for students receiving instruction via CAI with those of students receiving traditional instruction. Bundy (1964) and Fletcher, Suppes and Jamison (1972) report extensively on studies of this type. The reported results almost always favor CAI over traditional instruction, citing higher test results or improved functioning in terms of grade level (elementary students). The point which is often overlooked is that instruction via CAI usually consists of drill-and-practice sessions only. Thus, such studies are more likely reporting on the effectiveness of the drill-and-practice routine in reinforcing mathematical principles learned in the classroom, than on the effectiveness of CAI as the principle mode of instruction. It is difficult to be certain of this, however, since the details of the program under investigation are often omitted.

Edwards et al (1975) reviewed the literature on effectiveness of CAI. Their findings were as follows:

1) Traditional instruction supplemented by CAI was always more effective than traditional instruction alone. CAI usually referred to drill-and-practice.
2) When CAI was substituted for all or part of the traditional instruction 9 studies showed increased achievement scores with CAI while 8 showed no difference.
3) When different CAI modes were compared, none was consistently more effective than the others.

4) There was no difference between the effectiveness of CAI and other non-traditional methods such as tutoring or language labs.

5) In studies comparing retention with CAI and traditional instruction, 2 out of 3 provided some evidence that retention was less with CAI.

Some evidence also exists which suggests that CAI may be more effective for students who are economically, intellectually, and/or physically disadvantaged than for students who are motivated and oriented towards school achievement (Jamison, Suppes & Wells, 1974; Kearsley, 1977; Suppes & Morningstar, 1969). Morgan (1975) and Fletcher and Beard (1973) report improved performance of hearing impaired students especially in mathematics, using CAI drill and practice to supplement classroom instruction.

It is rare to find a study in which CAI was used for the total instruction of a course, but Petruk (1978) has reported such a study. First year electrical apprentices were divided into experimental (CAI) and control (classroom instruction) groups for courses in electrical theory and electrical mathematics. The experimental group received all instruction in these courses via CAI. When achievement scores were compared on common exams, no differences were found between control and experimental groups.

The evidence presented is less than conclusive. Generally, so little information is reported that it is impossible to know if the findings are comparable across studies. The question of retention remains virtually unanswered and one can only reasonably conclude that students learn via CAI at least as well as by classroom instruction alone.

Attitudes towards CAI

Another concern which might affect student performance when learning via CAI is the attitude of the student toward the instructional method. Problems arose again when comparing findings across studies in that some reported attitudes toward CAI as the sole mode of instruction, while others were looking at a more restricted use of CAI, the details of which were often lacking.

In the overall study of CAI, relatively few studies have examined attitudes toward learning via CAI, and most of those which have use experimenter constructed tests of unknown reliabilities (King, 1975). Generally, the programs under study are of short duration (less than 10 hours) and undoubtedly influenced by novelty effects of unknown quantity. Nonetheless, research findings, while inconclusive, are deserving of attention.

Hartley (1966), in reviewing work done in the early 1960's, found conflicting evidence. He lists 9 studies which reported favourable attitudes toward instruction via CAI, and 5 in which neutral attitudes were found. Students were reported to have a preference for working with both teacher and machine rather than either one alone. Mitzel (1967) reported mostly favourable attitudes although students stated they missed classroom discussion. High school chemistry students felt that CAI was superior to traditional instruction but still preferred the traditional mode because "the teacher has a personality" (Summerlin, 1971).

In her extensive review of the impact of CAI on student attitudes, King (1975) demonstrated the lack of definitive findings by showing that

while no study reported a decrease in attitude favorability following CAI use, some reported increased favorability and others reported no change. Finally, Lower (1976) cited two comments frequently made by students, namely that computer learning is no less impersonal than large lecture halls, and that computer learning allows one to make mistakes in private.

Some authors have attempted to determine which factors were more likely to be associated with positive attitudes toward computer based learning. However, the results were often contradictory. For example, it was reported that positive attitudes are: 1) not related to achievement (Borman, 1970; Eigen, 1963) or 2) related to achievement for females but not for males (Doty & Doty, 1964); 3) dependent upon aptitude (Mitzel, 1967) or 4) independent of aptitude (Broderick & Lovatt, 1975); 5) dependent upon the time taken to complete the CAI course (Mitzel, 1967) or 6) independent of time taken to complete the course (Borman, 1970). Some work has begun researching personality variables which are related to positive attitudes toward CAI but it is also inconclusive as yet. A statement from Levien (1972) sums up the situation:

> In any event, the evidence is clearly not consistent with the hypothesis that students hold fundamentally hostile attitudes toward instructional computer use. Their attitudes are more likely to be shaped by their perception of the quality of each specific application. (p. 541)

Levien's opinion that quality of application affects student attitudes toward CAI may be a valid one, although he offered no support for it. It is worthy of note, I believe, that the quality of a CAI program is virtually never discussed in writing. One might surmise that evaluations based on

poor quality programs would reveal poor student performance and negative attitudes toward learning via CAI. Osin (1978) has, however, not found this to be true. In his candid paper he has stated that CAI programs in his setting are often prepared by graduate students as projects. As such he felt most of them lacked the qualities of good instructional design and smooth operation associated with sophisticated answer analysis, branching, and record keeping. Despite this, he has found that students using these CAI programs rated CAI highly as a means of learning and achieve at a high level. This he has dubbed "The Survival Principle" - students will succeed despite poor teaching, either by teacher or terminal, by making extra efforts outside class. Osin's failure to support his hypothesis with data does not negate it as an alternate explanation, although one would hope for empirical support in the near future.

In all cases cited in this section thus far, the CAI programs used represent only a portion of the instruction in a particular course. Extrapolation of findings to the case where learning via CAI represents the total instruction for the course is not justified. For one thing, the length of the program in most cases was less than 10 hours. With such short programs, the students may view it as "time out" from regular classroom lectures, rather than a desirable mode of total instruction. The possibility of novelty effects has already been mentioned.

The University of Calgary has developed a program to teach degree-seeking nurses via CAI (Hannah, 1978). Initial reaction has been favorable and work is continuing. A recent report by Petruk (1978) involving electrical apprentices taking two courses entirely by CAI also noted

generally positive attitudes expressed by the students. Finally, Alderman, Appel and Murphy (1978) have compared the PLATO and TICCIT systems in use in community colleges. On the PLATO system, where less than one third of student instruction in a course was done via CAI, attitudes toward CAI were very favourable and 88% of students denied that the system was boring or dehumanizing. On the TICCIT system, where courses were taught primarily by computer, attitudes were favourable but less so than with PLATO. Students stated that they missed the interaction with the instructor. While not conclusive, there is some suggestion that CAI alone is less desirable for the student than both computer and instructor together. (It is worthy of note that the completion rates with TICCIT are are very low. For example in mathematics a 16% completion rate with TICCIT is contrasted with a 50% completion rate with the lecture method.)

Time Savings with CAI

There is very little to be said in this area as it is the one fact on which there is almost complete agreement - there are substantial time savings to be realized using CAI over conventional methods of instruction (Edwards et al, 1975; Grubb & Selfridge, 1964; Jamison et al, 1974; Petruk, 1978; Summerlin, 1971). Of course, this generally refers to savings for the student. If the author of a program is also course instructor, time not spent in class is usually more than made up for by time spent authoring the course. Hunka et al, (1976) estimated about 35-40 hours of author time to produce 1 hour of student time. Over a long run of usage, however, even the author/instructor may realize a time saving. Those who

question the time savings for the student (Osin, 1978) do so on the basis that no measures are made of out-of-class time spent on the course. The same is true, however, for students in conventional classrooms, so that at this time, this issue remains unresolved.

Summary

The following claims for the efficacy of CAI have been examined:

1) There is improved retention (achievement) when learning via CAI.
2) Students find learning via CAI to be enjoyable.
3) CAI requires less time for the student to reach educational objectives.

With the exception of time savings, the findings are inconclusive but seem to be in support of these claims, under certain conditions. For example, achievement seems to improve when CAI is used as a supplement to classroom instruction. Support for the claim of time savings for the student is virtually unanimous.

Historical Perspective

The use of computers in education began about two decades ago. Prior to 1965, use of computer assisted instruction (CAI) was confined mostly to the computer industry where it was used to train personnel (Suppes & Macken, 1978). There was some activity in elementary school mathematics before this, mostly of a drill-and-practice nature, but CAI did not really reach the university level until 1967 when a first year

course in Russian was offered which eliminated all classroom work (Suppes & Morningstar, 1969).

Two rather lengthy reports have been made of computer use in California (Comstock, 1969) and in Massachusetts (Rochart & Morton, 1975) which demonstrate use in higher education (in institutions beyond high school). Although these reports included both courses "with" the computer and "about" the computer, there was some indication of substantial use of the computer in teaching subjects other than computer science. At that time, the largest percentage of use was devoted to drill-and-practice and problem solving rather than tutorial mode.

On a more global level, Kearsley (1976a) has examined data derived from issues of Index to Computer Based Learning (Lekan, 1970; Hoye & Wang, 1973; Wang, 1976) and attempted to show trends in the use of CAI over time. (These indexes have some shortcomings as a data source, namely that all information is collected via questionnaire which is voluntarily filled out and returned by the institution, and that no attempt is made to verify incoming information. The fact remains, however, that the Index is likely the most complete source available.) His major findings are summarized as follows:

1) Instructional strategy - Drill-and-practice has remained the most popular over the period with tutorial showing a sharp increase in use in 1973 followed by a decline to previous levels by 1976.

2) Subject matter - Mathematics has maintained the highest number of programs over the entire period but a noticeable increase in courses in the health professions occurred between 1973 and 1976.

3) Source of programs - Very little consistency is shown in this area except at the University of Illinois and at the Coast Community College which have consistently produced the largest number of programs since 1972. (There is no precise meaning given to the term "program". According to the Index it may apply to the name of a course, a project, or a segment of a course. This must be borne in mind throughout the following discussion relating to numbers and length of programs.)

4) Length of program - The trend has been toward increasing length of programs. When average student completion times are compared across the years, one sees that in 1970, 95% of all programs were completed in 1-10 hours with 48% being completed in less than 1 hour. By 1976 only 88% of all programs were completed in 1-10 hours with only 38% being completed in less than 1 hour.

While some of these findings may sound encouraging, a closer look is necessary. Kearsley (1976b) has made an in depth study of CAI use in 1976 using the same source for his information as he used in his comparison of 1970-76. Since the vast majority of programs continues to be less than 10 hours in length, it appears that CAI is used mainly as an adjunctive method of teaching. It has not developed into a viable replacement for classroom instruction as was hoped in the early days. Even tutorial programs average less than 10 hours in length. The largest producer of programs, Coast Community College, with 519 programs reported in 1976, reports total average completion hours to be 324 or less than 2

hours per program.

Another interesting finding is that while subject matter seems to be increasingly varied, only 19% of the programs reported in the 1970 Index still appear in the 1976 Index. Although some of this may be due to the inaccuracy of the data collection method, at least part of the decrease is due to a general lack of long-term funding for such programs (Kearsley, 1976a).

As one peruses the literature on CAI, several facts become apparent. Firstly, the number of papers reporting evaluations of CAI programs has decreased drastically since 1974. Secondly, once an evaluation report has appeared, nothing further is published in the more common educational technology journals, in most cases. There is no indication as to the continuing status of such programs, what changes have been made, or the results of such changes. This leads one to wonder if the program was developed for purposes of the study and then abandoned. Lastly, there seems to be little new thought on the subject of CAI. To be sure, the question of the dehumanizing effects of CAI is resurrected periodically, and a few authors give advice on setting up a CAI facility, but it is only by examining a source such as the Index to Computer Based Learning that one has much idea of the status of CAI at present. This review has tried to demonstrate the inconclusiveness of earlier findings in evaluating the merits of CAI and the need for more evidence. However, such evidence does not seem to be readily forthcoming.

Once again we must turn to Kearsley (1976c). He outlines a number of scenarios as possible prospects for computer based education (CBE) in the future. In the first, he sees CBE as an enrichment medium much like audio-visual aides currently in use. The data on program length support

this scenario. In the second scenario, CBE is the major mode of instruction. Little support exists for this. The third scenario describes CBE as a research tool only, and the fourth calls CBE "an educational dinosaur" in which activity levels and research gradually fade into relative non-existence. The increased number of programs listed in the 1976 Index (Wang, 1976) seems to deny the last scenario but the 1978 Index (Wang, 1978) reports a decline in number of programs for the major producers, introducing some doubt as to the eventual status of CAI.

The CAI Facility at the University of Alberta

The CAI facility at the University of Alberta is housed in the Division of Educational Research Services (DERS) in the Faculty of Education. The hardware consists of an IBM 1500 system with 19 terminals. Each student station or terminal includes a CRT with a typewriter keyboard, a light pen, an image projector, and an audio play-record unit (Hunka, 1973). The facility has been operational since 1968 with the amount of equipment remaining constant since about 1970. Hunka (1973) has outlined 3 objectives - demonstration, research, and production - toward which energies have been directed. Production refers to the use of CAI courses by students. Programs available through DERS will be discussed in light of the stated objectives.

Demonstration

Demonstrations of the use of the computer have been made to many groups

both on and off campus, including thousands of school children. A program titled "DEMO" gives a standard introduction to the terminal, lasting 5-10 minutes, which is suitable for students in grade 6 or higher, as well as giving the student access to a wide range of games drills, tutorials, and simulations.

"DEMO" is an integration under one course name of many sub-sections illustrating the CAI capabilities of the system.

Research

The area of research must be considered to include not only research of the type discussed previously (i.e., the effects of learning via CAI) but also research with CAI. Examples of the latter include such things as administering published tests through the CAI terminal ("FIGUR" - Kagan's Matching Familiar Figures test, "tscs" - Tennessee Self Concept Scale), experimenting with new authoring languages (Romaniuk, 1970, using VAULT), and using the terminal to present stimulus items in studies unrelated to CAI directly ("SEMSA" - visual research, 'RECAL" - recall of nonsense trigrams, "PASSC" - paired associate learning task). Of the approximately 75 programs available through DERS, almost one third are of this type, developed for a particular research project but not subject to ongoing usage.

Production

It is sometimes difficult to distinguish between production and research. A program is usually produced out of some need, either to

offer some instruction which is otherwise unavailable or to provide an alternate or supplementary means of instruction. In order to determine whether or not the program is fulfilling that need adequately, research is undertaken.

Most of the programs available in DERS were produced (authored and programmed) there. One exception is "CARE1" which was produced at Pennsylvania State University to teach teachers early identification of handicapped children. It has been made available through DERS to teachers here.

The rest of the programs may be roughly divided into two classes: those which offer drill-and-practice or simulations as a means of reinforcing principles, and those which offer all or part of the instruction in a particular course. Many of the drill-and-practice programs are for elementary school mathematics ("ACCUM" - arithmetic drill for grades 2 to 6). Simulations are available for junior high school students ("FORST" - simulation of a lumber company operation), school administrators ("JARAC" - educational decision making), and medical students ("SLEEP" - simulation of anaesthesiological procedures), to mention a few. The use which is made of these programs is variable.

Programs which offer instruction as all or part of a course are numerous and subject to more regular use than the others. With few exceptions, they are designed for students at post-secondary institutions such as university or technical institutions. Table 1 summarizes the major programs.

Examination of the table reveals considerable variability in the duration of courses. (The times recorded represent average student completion times). The shorter ones obviously represent only one unit

Table 1

Summary of Major Tutorial Programs at University of Alberta

Course Name	Content	Duration	User/level
ANOV1	analysis of variance	2-3 hrs	university
APLLC	A Programming Lang. learner control	9 hrs	gr. 10-univ.
BASL1	basic electronics	50 hrs	univ./tech.
CADAV	health hazard appraisal program	10-15 mins	med. & nurs.
CAI8	intro. to color T.V.	20 mins	gr. 10-tech.
CARD1	cardiology	25 hrs	2nd yr. med. students
CARE1	identification handicapped children	25 hrs	university/teachers
CHNUR	fundamentals of immunization	1½ hrs	comm. health nurses
COMP	introduction to computers	7½ hrs	technical school
CWSH	Coursewriter II	15 hrs	gr. 10-univ.
FRAND	French	25 hrs	jr. & sr. high school
FUNDP	fundamentals of data processing	22 hrs	gr.7-adult
KAMRA	intro to photography	45 mins	univ./tech
PHARM	intro. to autonomic nervous system	2 hrs	univ.
PHONI	intro. to teaching phonics	15 hrs	univ.
STAT1	statistics & research	70 hrs	univ.
TESL	Eng. as a 2nd lang.	1½ hrs	gr. 4-univ.
TOOLS	tools in metal work	6½ hrs	univ.

of a regularly taught course while the longer ones may represent the total instruction in a course. From this list, the program which is of interest, and which will be described in detail, is "STAT1".

Description of STAT1

The information in this segment comes from Hunka, Romaniuk and Maguire (1976) as well as the author's personal experience with the program.

STAT1 is a computer-assisted instruction program in statistics offered at the graduate level as part of the course title, Educational Psychology 502. It includes topics ranging from descriptive statistics to analysis of variance and research design (See Table 2).

The program uses the tutorial mode of instruction which is supplemented with problem-solving and a few drill-and-practice exercises incorporated into the program where appropriate. Reviews of concepts are offered, with the student making the choice to review or advance to new material. Students may also review segments at any time by selecting the correct label and moving to that portion of the course.

Student responses are entered at the terminal either by using a lightpen to point at a response on the screen or by entering a typed response at the keyboard. Keyboard responses may involve entering the number or letter of the answer choice (as in multiple choice questions) or constructing a free response (either words or numbers) as the situation demands. Feedback on correct responses often takes the form of encouraging or congratulatory messages. Incorrect responses receive feedback in the form of hints and "try again" messages. The correct answer is

Table 2

Course Content of the Computer-Assisted Program Called STAT1

STAT1 Segment#	Description
0	Introduction
3	Descriptive Statistics
20	Area under the Normal Curve of the Binomial Distribution
4	Prediction and Correlation
5	Multiple and Partial Correlation
7	Knowledge of Terms in Inferential Statistics
8	Random Sampling Distribution of the Mean
9	Properties of Samples drawn from the Random Sampling Distribution
10	Hypothesis Testing
6	t-tests and Confidence Intervals
11	Purpose of One-Way Analysis of Variance (ANOVA)
12	Computation of One-Way ANOVA
13	Intuitive Approach to the Rationale of One-Way ANOVA
14	Algebraic Approach to the Rationale of One-Way ANOVA
16	Scheffe and Tukey Tests
17	Interaction and Two-Way ANOVA
19	Chi Square
25	Using a Computer to Process Data

usually only given after several incorrect attempts.

At the commencement of the program students are given a paper-and-pencil arithmetic test to determine the level of competency in basic skills. All other testing associated with STAT1 is achievement testing. Ten unit exams are given, six of which are taken at the terminal. "Right" or "wrong" is the only feedback offered at the time. A summary of performance is given at the end of each exam accompanied by a suggestion for review if achievement falls below a certain level (usually about 75%).

The average student completion time for the entire program is about 70 hours, excluding time spent on lab. assignments. At the end of each unit but before the exam, an attitude questionnaire is automatically presented to the student at the terminal (See Appendix A). The attitude questions are answered on a 7 point Likert scale with ratings on an agree/disagree format. The questionnaire attempts to determine such factors as whether the student found the material interesting, if he was already familiar with the material, and whether he would have preferred classroom instruction.

The program was first offered in its entirety in the summer of 1975. It was revised on the basis of data collected during the summer, and has been offered every summer since then. The STAT1 program was also utilized following the same format in the winter of 1976-77. Since then, Winter Session students have used STAT1 along with regular classroom instruction. The main difference between STAT1 taken in Summer Session vs. Winter Session is time. Summer students complete the program over a 6-week period while winter students have about 8 months

in which to complete the program. The implications of the shorter time period in which to complete the program are a more concentrated approach (in terms of daily attendance at the terminal) by the students, and lack of interference from other courses. The exact effects of the varying times for completion are unknown but each may have positive and negative aspects. For example, over an 8 month period, students could pace themselves at a rate of 3 hours per week rather than 3 hours per day, allowing more time for integration of new material, and more review time. At the same time, the tendency may be to leave the program when work from other courses piles up, and then try to catch up by working intensively at STAT1 for several days in a row. Generally it would seem that 6-week courses give the students fewer options for budgeting their time but less interference from the demands of other courses.

Students are generally from the various education departments (Educational Psychology, Educational Foundations, Elementary Education, etc.) but students from other faculties also take the course (e.g., it is compulsory for students enrolled in the Master's Degree program in Physical Education).

Besides test scores and attitude ratings, many types of data are collected on the students. These include answer analysis information (response time, correct, wrong, and unrecognized responses), time taken to complete each segment, previous knowledge of statistics, and comments made by students and typed in at the terminal.

STAT1 is the most lengthy program available through DERS. It covers the topic areas in a detailed and organized fashion which should

allow the student to carry through without much assistance from an instructor except for individual problems. The program is always accompanied by lectures on topics related to research design, such as reliability, validity and how these factors are affected by the design of an experiment. These lectures, however, constitute about 16 hours in the total program compared to the average terminal time of about 70 hours.

It is evident from reviewing the literature that little follow-up research on the effectiveness of CAI programs is published. As an attempt to fill the need for follow-up a study is proposed to investigate the retrospective perceptions of students who have completed the STAT1 program, and also to gain some measure of follow-up achievement in the program.

The specific questions to be addressed by the present study are:

1) Did achievement scores six months to 2 years after course completion differ from those gained at the time of initial testing?
2) Did retrospective perceptions of the STAT1 program differ from those noted at the time of initial testing?
3) Did the amount of reported use of statistics have any relationship to follow-up perceptions or achievement scores?
4) What were the specific factors which tended to be associated with positive and negative attitudes toward STAT1?
5) How helpful were features outside STAT1, such as laboratory assignments and research design classes, perceived to be?

Chapter 3

Methodology

Subjects

The subjects employed in this study included all those for whom an address could be obtained who had completed the STAT1 program as it was used in Educational Psychology 502 during Winter Session 1976-77, Summer Session 1977, Spring Session 1978, and Summer Session 1978. The total number of students completing the program in the sessions listed was 114. Of these, addresses were obtained for a total of 93 persons. The remaining 23 subjects were spread fairly evenly over all groups, (See Table 3), with the 1977 group losing the greatest number of potential subjects. The groups are referred to as Group 76, Group 77, and Group 78, the number denoting the year in which the program was begun.

Although STAT1 has been in full operation since Summer Session 1975, persons completing the program before Winter Session 1976-77 were eliminated, for two reasons. Firstly, it was felt that these people would be very difficult to contact, given the length of time intervening. Secondly, the course instructors believed that the early groups of students had, in fact, been treated differently. Owing to the novelty of the program and resultant enthusiasm, the instructors felt that they had spent more time with the students, assisting and encouraging them. There had also been several changes made to the program, based on the experience with, and feedback from, the early groups of students. The STAT1 program has, however, remained fairly stable since the commencement of Winter Session 1976-77.

The groups chosen for this study were assumed to be equal except

Table 3

Examinee Sampling and Response Rates

Group	No. completing Course	No. for whom Addresses Available	Questionnaires Returned	% Returned
76	33	27	10	37
77	35	21	10	48
78	49	45	24	53

on one factor: Group 76 (G76), completed the program over 26 weeks while Groups 77 (G77) and 78 (G78) completed the program over six weeks of intensive study. No information was available on persons who dropped the course before completion. In 1976-77 five persons withdrew from EdPsy 502, but two reregistered in 1977 and completed the course. There were three dropouts in Summer 1977 and three in Summer 1978.

Materials

Since the main focus of this study was on retrospective perceptions of the STAT1 program and on retention over time, it was necessary to develop paper-and-pencil questionnaires which could provide measures of perception and achievement for comparison with the initial measures of perception and achievement taken at the completion of the program.

STAT1 Opinionaire

This questionnaire (See Appendix "B") was constructed by modification and expansion of the questionnaire which students completed at the end of STAT1. Items which were considered irrelevant to the study (e.g. those requesting demographic data) were eliminated, while others were reworded to better fit the post hoc nature of the study. In addition, all three instructors involved in the program were asked to submit suggestions for items which would tap particular areas of concern, especially content and emphasis of the program.

The result was a 31 item questionnaire, the majority of which could be responded to by marking the appropriate area on a seven point Likert scale. Estimated time for completion of the total questionnaire was three to five minutes.

Achievement Questionnaire

The greatest difficulty in gaining a reliable estimate of achievement was seen to be the time required of the subject to complete a questionnaire which adequately sampled the course material. A decision was made, based on the writings of Shoemaker (1970a, 1970b, 1971) and Lord (1962), to use matrix sampling procedures to estimate mean achievement scores, and thus reduce greatly the time commitment required of an individual subject.

Briefly, Shoemaker (1970a) has shown that if test items are divided into "t" subtests and each subtest is administered to a different set of examinees, the results obtained on each subtest may be averaged to provide a single estimate of the population mean and variance. Shoemaker (1970b) has further demonstrated that the degree of accuracy in estimating the population mean and variance using item-examinee sampling procedures is a function of the number of observations obtained, rather than the procedure itself. An observation is defined as a single item on a single subtest administered to a single examinee. The total number of observations is then determined by Number of subtests x Number of items per subtest x Number of examinees per subtest. In general, "the greater the number of observations used, the smaller the standard error of estimating u and σ^2." (Shoemaker, 1971, p. 218). Beyond 1200 observations, gains in accuracy of estimation are small, provided adequate item sampling has occurred.

A bank of 132 items was available from those items which appeared on the final examinations used for each of the three groups. These items were grouped according to subject matter, following the course outline for STAT1 (See Table 2). The resulting 10 groups of subject matter

were then compressed into five larger groups by combining subject areas which seem to go together (e.g. Descriptive Statistics and Area Under the Normal Curve were combined).

Six 15-item stratified achievement tests were then formed by random sampling without replacement from each of the five groups of items, using a table of random numbers. Subject matter grouping and item selection occurred as shown in Table 4.

Three of the subtests were mailed to 15 examinees each while the remaining three subtests were mailed to 16 examinees each, for a potential total of (3 x 15 x 15) + (3 x 15 x 16) = 1395 observations.

Procedure

A package was prepared for mailing to each of the 93 subjects. Each package contained a copy of the STAT1 opinionaire, a 15-item achievement test, a stamped return envelope addressed to the author, and a covering letter (See Appendix "C"). Subjects living in Edmonton were contacted by telephone to explain the nature of the study and to elicit their co-operation. Questionnaires were mailed on January 4, 1979 with return requested by January 22, 1979. Subjects living in Edmonton were contacted again by telephone if their completed questionnaires were not received by January 24.

All questionnaires were coded as subjects were not required to identify themselves. Care was taken to ensure that approximately equal numbers from each group received each of the six achievement tests. The time estimated to complete both questionnaires was about 45 to 50 minutes, the bulk of

Table 4

Subtest Item Distribution According to Content

Subject matter	Total items	No. selected for each subtest
Descriptive statistics, area under normal curve	33	4
Prediction and correlation, multiple and partial correl.	25	3
Hypothesis testing, t-test, Chi square	25	3
One way ANOVA, interaction, Tukey and Scheffe tests	20	2
Research design, computer processing of data	29	3
Total	132	15

this time being devoted to the achievement test. Subjects were instructed in the covering letter to treat the achievement test as an open book exam since this was the format used by the course instructors. Response rates are shown in Table 3.

The overall response rate was 44 persons or 47% of the total possible. Of the 44 subjects who responded to the questionnaires, 39 (42% of total possible) completed both the achievement test and the opinionaire. The remaining five subjects completed only the opinionaire. The initial response from subjects contacted by telephone resulted in 52 persons agreeing to participate in the study. When the second telephone contact was made following the deadline for returning the questionnaires, a brief interview was conducted to determine the precise reason for the delay. For example, subjects were reminded of the deadline and asked if they had forgotten or had changed their minds about participating. If the latter response was given, the matter was pursued further. Where subjects stated that it would take longer than 45 minutes to complete the achievement questionnaire, they were asked to complete the opinionaire. Five subjects agreed to do this.

Analysis of the Data

Achievement

The achievement test scores were converted to percentages and the mean and standard deviation were computed for 39 subjects. The final course grades received by these subjects were gathered and the mean and standard deviation also computed. A Pearson correlation coefficient was calculated between the two sets of achievement scores.

Opinion Data

Each of the 27 opinionaire items which required the subject to rate their preference on a seven-point scale was examined. The integer value of the rating level selected by the individual was used as the score for that person on that item, with the response indicating least agreement (Strongly Disagree) or most negative attitude being scored one and the response indicating the most agreement (Strongly Agree) or the most positive attitude being scored seven. The scores for the following items were reflected to conform to this scoring regime:

Item 7 It would have been easier to learn the STAT1 material by classroom instruction rather than by computer instruction.

Item 8 The material in the program was boring -- interesting.

Item 11 What portion of the material covered in STAT1 had you previously been taught? None -- All.

The mean and standard deviation of the scores on each item were calculated and Pearson correlation coefficients were computed for all possible pairs of items as well as between opinionaire items and achievement test scores and final grades. Only correlations between scores related to achievement, expressed liking for STAT1 and perceived usefulness of the material learned will be discussed in the next chapter.

Chapter 4

Results and Discussion

The data collected for analysis consisted of responses to 27 opinionaire items plus achievement test scores, final grade scores, and end-of-course opinion data. In all, 44 subjects responded to the follow-up questionnaires; 39 of these responded to both questionnaires. The remaining five subjects declined to complete the achievement test. At initial contact, 52 persons verbally agreed to participate in the study. However, of these 52, only 38 partially or completely fulfilled the commitment. Six persons who had been contacted by mail only also participated. The overall response was disappointing in light of the initial cooperation received. Therefore, an attempt was made to ascertain the reasons for subjects' failure to cooperate. The subjective, informally gathered feedback will be integrated, where possible, into the discussion of the findings.

The possibility of having a biased sample was considered and a number of checks were made. First, the final course grades for respondents and non-respondents were rank ordered to determine if respondents tended to cluster at one end or the other. Respondents were evenly distributed throughout the range. Next the proportion of respondents from each of the university departments represented were compared. Educational Psychology students had the greatest response rate (60%) with other Education departments having response rates 25% or higher. Only Physical Education was poorly represented with a 15% response rate. The high Educational Psychology response rate is

explained by the fact that two-thirds of all students in the 1978 Group came from this department so they were the most accessible to this study. The low response rate from Physical Education students is explained by the fact that two-thirds of the students in this department were in the 1976-77 Group and only two were still in the city. Finally, the Educational Psychology students were classified into the three areas of study within the department (Basic, Special Education, and Counselling) to see if one area was proportionally better represented than the others. Counselling students had a much higher representation (85% compared to 50%) than the other two areas. Thus it may be said the respondent group is more representative of counselling students in Educational Psychology than of any other group participating in the study.

Achievement Data

Scores were examined in an overall manner as well as according to groups, as shown in Table 5. For the 39 subjects who wrote the Achievement Questionnaire, the mean score was 57.79% with a standard deviation of 18.27%. The mean of the final course grades for these subjects was 79.45% with a standard deviation of 10.74% (n=38, see note, Table 5). The correlation between final course grades and achievement test score was .45 (p .01).

For all groups tested, mean achievement scores dropped to more than 15% below mean final grades while the standard deviation doubled or tripled that of the final grades. No statistical tests were performed because a) G76 and G77 contained very small numbers of subjects for whom complete data were available, and b) multiple matrix sampling

Table 5

Mean Achievement Test Scores and Final Grades By Group

	26 weeks 1976-77	6 weeks 1977	6 weeks 1978
Achievement Scores (n=38)	51.43[1] (21.45)[2] n=7[3]	67.71 (15.16) n=7	55.83 (17.43) n=24
Final Grades (n=38)	73.86[4] (19.87) n=7	85.14 (3.67) n=7	79.42 (7.72) n=24
Total Class Final Grades (n=114)	76.04 (6.98) n=32	81.74 (5.97) n=32	76.43 (9.43) n=50

1 all values are expressed in %
2 standard deviations of percents in parentheses
3 n=8 subjects completed the Achievement Questionnaire but one was eliminated from this calculation as she had audited Educational Psychology 502 and no final grade was available.
4 this discrepant value occurs because one subject in the sample did not finish the course and received a failing grade of 31.32%.

procedures were used to gather the achievement test data, thus raising doubts about the validity of assuming these small amounts of data to be truly representative of achievement for the entire group. In order to estimate population means and variances using matrix sampling procedures, Shoemaker (1970b) has demonstrated that standard errors of estimate are small when more than 1200 observations are gathered. In this case, less than 600 observations were obtained overall, and the number obtained for each group is therefore too small for reliable estimation of population parameters. In Group 76 (G76) and Group 77 (G77), some subtests were responded to by only one person, hence the variance of the items is zero and standard errors of estimate cannot be calculated.

The difference between achievement test scores and final course grades for study participants was very similar for all groups despite the fact that the time elapsed since taking the course ranged from six months to two years. It might be hypothesized that persons taking the course in 1976-77 would have made more use of the material learned, and hence maintained a higher level of achievement. This did not appear to be the case, however. Reported use of statistical knowledge for thesis and general work was about the same for all groups, ranging from a mean of 3.57 on a seven-point scale to 4.71 for thesis use, and from 3.44 to 4.33 for general use. There was no evidence to suggest that only the highest achievers in the 1976-77 group participated since the rank order on final grades was 1, 3, 8, 11, 18, 20, 21 and 34 out of 35 for those who participated in this study.

An alternative explanation is that taking the program over a longer

period of time (over an eight month session as opposed to six weeks) allowed for better integration of the subject matter resulting in the maintenance of higher achievement levels. This hypothesis was partially supported by reports from students taking the program over a six week period who stated that, "There is too much material to be covered in such a short time". The motivation for many students to take the program over the shorter sessions was reported by them as being "to get it over with as fast as possible", and few acknowledged the value of the knowledge gained even in helping them to understand and critique published articles.

Usefulness and Expressed Liking for STAT1

In order to gain some understanding of the students' perceptions of STAT1 regarding learning the material via CAI, attention was paid particularly to those items on the Opinionaire which dealt with reported usefulness of the program and expressed liking for it.

The questions which related to liking STAT1 were as follows:

V8 It would have been easier to learn the STAT1 material by classroom instruction than by computer instruction.

V9 The material in the program was boring -- interesting.

V18 I liked taking statistics via computer-assisted instruction.

V19 Taking statistics via computer-assisted instruction was a good investment of my time.

V20 I would recommend the STAT1 program to other graduate students or educational personnel.

The intercorrelations of these variables are shown in the Table 6.

Table 6

Intercorrelations of Achievement Variables and Variables Related to Liking STAT1
(n=44)

Variable	V8	V9	V18	V19	V20	ACHIEVE	FINAL
V8	1.00	.25*	.47***	.25*	.56***	.39**	.007
V9		1.00	.56***	.46***	.59***	.42**	.16
V18			1.00	.71***	.58***	.41**	.08
V19				1.00	.70***	.44**	.41**
V20					1.00	.38**	.24
ACHIEVE						1.00	.45**
FINAL							1.00

* significant at .05
** significant at .01
*** significant at .001

The correlations of variable 8 (V8) with variables 9 (V9) and 19 (V19) represent the minimum values which are significant at α=.05, suggesting that preference for classroom learning over CAI is weakly related to how interesting the material is perceived to be and to whether taking statistics via CAI was a good time investment. Perhaps students were reacting to the freedom one has to take a break from the computer at any time and thus alleviate boredom, fatigue, or frustration at one's own choosing.

Other variables are moderately to highly (V19 with V18 and V20) intercorrelated, suggesting that responses of students to one aspect of liking STAT1 tend to be quite similar to their responses to other aspects of liking STAT1. Table 7 illustrates the mean rating on items which expressed liking for STAT1, and, where possible, compares the average response levels on follow-up with those obtained at the completion of the course. No such comparison is possible for Group 76 since this opinionaire was developed in 1977. The original response levels are for the entire class (for G77, n=32; for G78, n=36). Since the opinionaires were done anonymously, it was not possible to separate out only those who participated at follow-up.

From Table 7 it can be seen that the follow-up scores among the groups are markedly similar and that in no case do the follow-up scores differ from the original scores for the group by more than .6. Despite a considerable drop in mean achievement scores, the students tended to express continued positive attitudes toward the STAT1 program.

At this point, it might be useful to reiterate that the subject being considered here is the CAI program and students' perceptions of it as a learning device. It may not be inferred from these data that

Table 7

Original and Follow-up Means of Expressed Liking for STAT1

	G76	G77		G78	
Variable	Follow-up	Original	Follow-up	Original	Follow-up
V8	5.7	5.3	5.8	5.6	5.4
V9	4.8	5.2	4.9	4.9	4.5
V18	6.1	5.9	5.9	5.7	5.6
V19	5.1	5.8	5.8	5.5	5.3
V20	4.9	5.8	5.2	5.4	5.2

students are expressing their feelings toward the subject matter per se. As will be shown later, the students reported only moderate use made of the material learned. In general, informal interviews conducted with participants and non-participants revealed some very negative attitudes toward the content or general area of the program, i.e. statistics. Comments included suggestions that a) statistics had no applicability for students in counselling psychology, b) the only content of value was that covering research design, and c) statistics could be used to manipulate data to give whatever results are desired, "so why bother?". Not all students displayed such negativism but the numbers who did were sufficient to warrant mention.

Opinionaire items which related to the perceived usefulness of STAT1 are as follows:

V7 I found the STAT1 program was useful in helping me learn statistics.

V19 Taking statistics via CAI was a good investment of my time.

V22 How useful was (is) the material learned in Ed. Psych. 502 in doing your thesis?

V25 How useful was (is) the material learned in Ed. Psych. 502 in your general work situation.

The intercorrelations of these variables are shown in Table 8.

One opinionaire statement appears in both categories of liking and usefulness since it was felt that a judgement as to whether taking STAT1 was a good investment of a student's time could easily be related to both.

The intercorrelations of the "usefulness" variables are less clear-cut than for the "liking" variables. It appears to be the case that use of statistical knowledge in the general work situation is unrelated

Table 8

Intercorrelations of Achievement Variables and Variables Related to the Usefulness of STAT1

Variable	V7	V19	V22	V25	ACHIEVE	FINAL
V7	1.00	.59***	.45**	.16	.36**	.30*
V19		1.00	.68***	.38**	.44**	.41**
V22			1.00	.25	.31	.44**
V25				1.00	.26	.08
ACHIEVE					1.00	.45**
FINAL						1.00

* significant at .05
** significant at .01
*** significant at .001

to any of the other variables except V19 (Taking statistics by computer-assisted instruction was a good investment of my time). Usefulness of statistical knowledge in doing a thesis, however, is moderately related to "I found the STAT1 program was useful in helping me learn statistics." ($r=.45$, $p<.01$) and more strongly related to "Taking statistics via computer-assisted instruction was a good investment of my time." ($r=.68$, $p<.001$). Quite obviously, those students who found the material useful in doing a thesis might be expected to report the program as having been a good investment of their time. The questions which arise from this are the amount of actual use reported by the students, and perceived value of the time invested in the program at follow-up compared to when the program was taken.

Table 9 illustrates the mean ratings given by the subjects in the study sample as well as the class mean ratings taken at the time of finishing the program, where these are known.

Table 9 shows lower mean ratings for all groups on the variables dealing with application of statistical knowledge to thesis or general work than for variables dealing with the usefulness of STAT1 in learning statistics. Generally subjects expressed the sentiment that although they had liked taking the course by computer, and had achieved well on examinations, they felt they had attained little true understanding of the material and hence little ability to apply it. Students who had this insight have, nevertheless, continued to report that taking the program was a good investment of time for them, as evidenced by the close equivalence of original and follow-up scores on variables V7 and V19.

Table 9

Original and Follow-up Means of Perceived Usefulness of STAT1

Variable	G76	G77		G78	
	Follow-up	Original	Follow-up	Original	Follow-up
V7	5.4	6.0	5.3	5.6	5.2
V19	5.1	5.8	5.8	5.5	5.3
V22	3.6		4.1		4.5
V25	3.9		3.4		3.9

In summary, little change occurred in students' perceptions of the STAT1 program over time. Moderately strong liking for learning statistics via computer and the sense that taking the program was a good investment of their time have prevailed even though only low moderate applicability was reported. Since the bulk of the students participating in this study are in the Master's program and may not have begun a thesis yet, this seeming lapse in consistency may alter in time.

Perceptions of Other Aspects of STAT1

Apprehension

Subjects were asked to rate their apprehension towards taking Educational Psychology 502 (EdPsy 502) and then to indicate the reasons for this. The mean level of apprehension reported for the 44 subjects was 4.18 on a seven-point scale. The main reasons for this apprehension were related to dislike for mathematics, doubt about ability to do statistics, and doubt about the value of such a course.

In general, it was found that persons reporting higher levels of apprehension tended to have less previous knowledge of statistics ($r=-.43$, $p<.01$), to find the content more difficult to understand ($r=-.53$, $p<.001$), and to rate the difficulty level of STAT1 to be higher ($r=-.60$, $p<.001$) than persons with lower ratings of apprehension. There was also some tendency for the "high apprehension" people to rate the material as less interesting ($r=-.36$, $p<.01$), and to obtain moderately lower final course grades ($r=-.34$, $p<.05$) than the "low apprehension" people. The program apparently does not provide enough reassurance to reduce anxiety in those with high initial apprehension.

The initial fears and apprehensions may prove to be well-founded for the student and interfere somewhat with learning, thus maintaining or even increasing the negative feelings toward the course content.

Difficulty Level

It has already been reported that more apprehensive students tended to rate the content as being more difficult. The mean difficulty rating for the 44 subjects was 4.39. As might be expected, persons who had some previous knowledge of statistics tended to find the content easier to understand ($r=.57$, $p<.001$) and to report increased liking for taking statistics by computer ($r=.33$, $p<.05$). Since self-pacing was the most frequently reported advantage of STAT1, it is reasonable to presume that persons with previous knowledge of statistics preferred not to risk being held back by students with no previous knowledge, as might occur in a classroom setting. Reported difficulty of content did not relate very highly to final course grade ($r=.26$, $p<.05$) which could be partially a function of the low variability of final course grades, although the general difficulty level of STAT1 did correlate moderately with final course grades ($r=.41$, $p<.01$). (Individual pacing of instruction and examinations allows students to be assessed when they feel ready, resulting in less variability of course grades.)

Research Design

The number of lectures on research design received by each of the groups varied, with G77 subjects receiving the fewest. The research design component of EdPsy 502 is adjunctive to the STAT1 program, and

therefore is offered only in lecture style. When asked to indicate their preference for having research design taught by computer instruction, the mean response for the 44 subjects was a low 2.98 on a seven-point scale, in favor of learning research design by computer. Overall the subjects would prefer not to learn research design on the computer. This coincides with a disadvantage of learning by computer reported by 10% of the subjects as "lack of opportunity to interact with students and teaching staff".

Several persons reported wanting more research design included in the course. This seems to be an area of concern and possible need for change since those who wanted more research design classes tended to report less use of statistical knowledge in doing a thesis ($r=-.47$, $p<.01$). With the bulk of statistical calculation being done by computers using prepackaged programs, the burden of designing a study may take precedence over the actual application of computational techniques. Another consideration is that many students reported feeling uncomfortable with mathematical principles and for them, increased emphasis on design may represent the opportunity to grapple with research successfully in a non-mathematical (i.e. less threatening) way.

Use of Knowledge Gained

This has been partially discussed previously but will be covered in more detail here. Subjects were asked to rate the amount and type of use they had made or were making of the knowledge gained in EdPsy 502. The type of use was divided into two categories, active and passive.

Active use was defined as the calculation of statistics while passive use was defined as reading research articles, critiquing the work of others, or advising others. Use was further subdivided into thesis use and use in the general work situation. Thesis use of the knowledge gained in EdPsy 502 was reported to be somewhat more active than passive (total thesis use with active use $r=.73$, $p<.001$; total thesis use with passive use $r=.54$, $p<.01$). General use of knowledge gained tended to be somewhat more passive than active (total general use with passive use $r=.71$, $p<.001$; total general use with active use $r=.59$, $p<.001$).

Laboratory assignments can provide the practical experience of handling numbers and formulae, helping to reinforce applications and promote learning. When asked to rate the helpfulness of the labs which accompanied STAT1, subjects gave a mean rating of 5.53. As subjects reported labs to be more useful, they also reported increased active use of the material learned in doing a thesis ($r=.40$, $p<.05$). This suggests that the laboratory assignments are fulfilling a valuable purpose for the students in helping them to analyze their own research data.

The actual amount of use of statistical knowledge in either an active or passive role was reported to be higher by students who achieved higher final grades ($r=.44$, $p<.01$) and by students who felt that taking STAT1 was a good investment of their time ($r=.46$, $p<.01$) than by students who achieved less well. While indicating encouraging trends, these figures must be viewed cautiously as they include ratings for only 30 subjects. The remaining 14 subjects did not rate thesis use, stating that they had not yet begun a thesis.

Other CAI Courses

Although few other full length university level courses are available on computer at the University of Alberta (apart from Faculty of Medicine programs), students were asked whether they had taken any other courses via CAI and whether they would like to take others. Few students had had any other experience with CAI but a mean rating of 5.39 indicated that most were in favor of taking other courses via CAI. As could be expected, those who were most in favor of taking other courses by computer indicated greater liking for STAT1 ($r=.55$, $p<.001$) than those who were less in favor of taking other courses via CAI, reported that taking STAT1 was a good investment of their time ($r=.40$, $p<.01$), and said they would recommend STAT1 to others ($r=.35$, $p<.01$).

To summarize, students who were less apprehensive about EdPsy 502 achieved well in STAT1, reported more positive attitudes toward computer-assisted instruction, and made greater use of the material learned in the program than those who were more apprehensive at the outset. The apprehensive students were moderately less successful in the course, expressed less positive attitudes, and made less use of the knowledge gained.

Review of Research Questions

Several research questions were stated in Chapter 2 as the specific issues to be addressed in this study. By way of summary, those questions are restated and addressed below.

1) Did achievement scores six months to two years after course completion differ from those gained at the time of initial testing?

Scores for all subjects tended to be about 20% lower at follow-up

testing than at initial testing. This experience occurred regardless of the time span between testings.

2) Did retrospective perceptions of the STAT1 program differ from those noted at the time of initial testing?

Attitudes toward STAT1 and learning via CAI tended to remain high for all subjects.

3) Did the amount of reported use of statistics have any relationship to follow-up perceptions or achievement scores?

There was little relationship between the amount of use made of statistics and the achievement scores of subjects in the study. There was, however, a tendency for subjects who made greater use of the knowledge gained to report more positive attitudes toward STAT1.

4) What were the specific factors which tended to be associated with positive and negative attitudes toward STAT1?

Positive attitudes tended to be associated with having some previous knowledge of statistics prior to using STAT1, as well as with perceiving the material to be useful. Negative attitudes tended to be associated with apprehension about taking a statistics course, lack of previous statistical knowledge, and doubt about the usefulness of the material to be learned.

5) How helpful were features outside STAT1, such as laboratory assignments and research design classes, perceived to be?

In general, students reported the lab assignments to be very useful. The research design classes were frequently isolated as the most useful component of the EdPsy 502 course, with many subjects stating a desire for more classes in this area.

Subjects also offered their opinions regarding additions and deletions which could improve the STAT1 program. These were discussed in Chapter 5.

Chapter 5

Summary, Recommendations and Conclusions

Summary

A review of the literature on the use and evaluation of computer-assisted instruction in education revealed a paucity of detail reported about the CAI programs in question. Details such as length of time to complete the program, type of teaching mode employed, and the particular purpose of each program (i.e. supplementary to, or replacement for classroom instruction) were most often lacking. All of this made comparison of findings about attitude and achievement associated with CAI difficult, if not impossible. The general consensus reported by the literature regarding the state of CAI at present was that it serves not as a replacement to classroom instruction but as a supplement to it. Very few programs seem to function in an ongoing manner as the sole mode of instruction, although there is evidence that some programs have been used successfully for varying periods of time.

The computer-assisted instruction facility at the University of Alberta was described in some detail with attention finally focussed on one particular program called STAT1. This program takes about 70 hours of terminal time to complete, and represents the bulk of instruction in a graduate level course in statistics titled Educational Psychology 502. The only classroom instruction associated with the program consists of lecture/seminar sessions dealing with research design considerations. These sessions supplement the STAT1 program, rather than vice versa.

The STAT1 program has been functioning since the summer of 1975. While continuing ongoing analysis of student progress has been carried out, no attempt has been made to conduct follow-up comparisons of attitude or achievement since the inception of the program.

The purpose of the present study was to compare follow-up attitude-toward-CAI ratings and achievement scores with attitude and achievement measures gathered while students were taking the program. An attempt was also made to gauge the amount of use former students had made of the statistical knowledge they had gained.

Students who had taken the course during the winter of 1976-77, the summer of 1977, and the spring and summer of 1978 were identified as subjects for the study. During these sessions 114 persons had completed the program but the whereabouts of only 93 people were known. Each of these 93 people was mailed a package containing a 15-item achievement test, a 31-item opinionaire, and a covering letter explaining the purpose of the study and requesting their cooperation and participation. The achievement tests were prepared using multiple matrix sampling procedures so that each subtest would be short enough to encourage cooperation of the subjects, yet allowing estimates of population parameters to be made. In all, only 44 persons participated in the study, despite additional personal contact being made with as many potential subjects as possible, and thus estimating confidence intervals for population parameters could not be done.

From the responses of these 44 subjects, contrasts were described between scores on the 15-item achievement test and the final course grade received by each subject, as well as between ratings on opinionaire

items at follow-up and at the time of course completion. Only 39 of the 44 subjects completed the achievement test. For these 39 subjects, the mean score was 57.79% with a standard deviation of 18.27%. The mean of the final course grades for these subjects was 79.45% with a standard deviation of 10.74%. The Pearson correlation between final course grades and achievement test scores was .45 ($p<.01$).

Opinionaire items dealing with expressed liking for CAI as a teaching modality, and with the use made of the material studied, were singled out for additional comparisons. Pearson correlations were computed between various aspects of expressed liking for CAI and perceived usefulness. Certain other items, such as those dealing with apprehension about taking the course, usefulness of laboratory assignments, and research design were also examined. A summary of the results indicates that little change occurred in students' perceptions of the STAT1 program over time. Moderately strong liking for learning statistics via computer and the sense that taking the program was a good investment of their time have prevailed even though only low moderate applicability has been reported. Students who were less apprehensive about EdPsy 502 achieved well in STAT1, reported more positive attitudes toward computer-assisted instruction, and made greater use of the material learned in the program than those who were more apprehensive at the outset.

Because the overall response rate was considerably lower than anticipated, a brief interview was conducted with all those who initially agreed verbally to participate and then failed to do so. The purpose of the interview was to determine which factors brought about the change

of mind. The most common problem expressed by subjects was lack of knowledge. Most felt they could not remember enough to attempt the achievement test without doing an extensive review of their statistics notes. Without exception, they stated that they could not possibly respond to the 15 items in the 45 minutes suggested on the questionnaire. When this topic was pursued further, many revealed not only a desire to do well on the test (despite the guarantee of anonymity), but a fear of not doing well such that it resulted in their complete failure to attempt the items. In most cases, this fear of failure on the test did not translate into any desire to upgrade their knowledge and skills in statistics but rather into a hesitancy to acknowledge what they already felt to be true. Nearly a dozen subjects made statements along this theme: "I got a good grade in the course but I know I've forgotten a great deal. It's just kind of a personal thing, feeling you have to meet the standard you set before, and not wanting to try unless you know you can do it.". This reluctance to attempt the achievement questionnaire accounts for the discrepancy between the number of persons responding to it and the number responding to the opinionaire, since five persons agreed to do only the opinionaire.

Recommendations and Conclusions

The purpose of this study was to conduct a follow-up evaluation of the computer-assisted instruction program called STAT1, designed to teach statistics at the graduate level in Educational Psychology. Those features of particular interest were the attitudes of the students to various aspects of learning by computer, and an estimate of learning

retention over time. Ignoring, for the moment, attitudes toward statistics as a content area, it seems fairly clear that, for the most part, students who participated in the course liked the teaching medium and continue to hold a favorable attitude toward CAI six months to two years later. When making recommendations, however, it would be unwise to ignore attitudes toward the content of the course, particularly as the mere mention of statistics seems to produce a highly negative affect in many people who take the course.

In the process of collecting the data for this study, it became increasingly evident that most people had taken the course because it was required as part of their graduate program, and not because they recognized the value of understanding statistics. The heavy demand for the course over the shorter sessions in spring and summer reinforce this view. Little can be done about the attitudes people develop elsewhere toward statistics but consideration could be given to ways in which the value of understanding statistics might be made evident to those taking the program. Adopting an attitude which reflects recognition of the difficulties encountered by those who consider themselves to be poor at mathematical conceptualization is a first step, but this should be accompanied by efforts to demonstrate the value of statistical knowledge.

Expand the course length

One might begin by expanding the time available for the completion of the program. Students all have their reasons for taking courses in the spring and summer months and often it is a fast way to "knock off another course". Since many subjects in this study reported that there was too much material in STAT1 to be covered in six weeks, perhaps

students would be prepared to take the program over ten or twelve weeks (e.g. Spring and Summer Sessions combined) while still realizing a time saving over regular Winter Session programs of 26 weeks.

Expand the research design component

A frequent request made by subjects was that more time be spent on research design. If the completion time were expanded from six to twelve weeks, some additional time could be devoted to this subject matter. The lecture/seminar sessions could be organized to correspond to the segments of STAT1 where appropriate. A schedule indicating the correspondence between lectures and STAT1 would encourage students to pace themselves so that the appropriate segments were completed before the lecture component. The schedule of research design classes given in 1978 indicates that only one 2-hour session was devoted to critiquing experiments. Two or three such sessions looking at published studies and the students' own work would not be unreasonable. Other topics which might be included are types of evaluation studies, alternative sampling procedures, and the use of multiple baselines.

Additions to STAT1

Most requests for changes in STAT1 came in the form of additions to the program such as more concrete examples and a broader range of applicability. If such additions are eventually made, it could also be helpful to emphasize, through concrete examples and comparisons, when a particular statistical test should be chosen over another. Although applicability is discussed as each new test is encountered, nowhere are the various statistical tests brought together so that the differences can be emphasized.

A further addition to STAT1 might be a segment consisting of a bank of research problems which could be gleaned from published studies and used as practice problems to give the student experience in designing studies to answer fairly specific questions. Taken in a step-by-step manner, the student could select from several alternatives or supply his own responses in much the same way as the medical students work through problems of patient diagnosis and treatment. Learning from this segment could then be augmented by having students submit written critiques of research articles.

Laboratory assignments and data processing

The STAT1 segment which deals with processing data using the computer (segment 25) was ranked by subjects as being one of the most useful in helping them analyze data for a thesis. Despite the recognized value of this segment, changes could be made to make it easier to deal with. Much of the first half of this segment is text with no problems or questions calling for a response from the student. If the textual information were made available in the form of a printed handout, students could read the material beforehand and come to the CAI terminal prepared to work through the practical problems of writing format statements, preparing data cards, and submitting a batch job.

Since the laboratory assignments were generally reported to be a helpful addition to STAT1, several sets of data could be made available which would be suitable for analysis using the different computer programs for t-test, ANOVA, Chi Square, and Pearson r. Most data analysis is done by graduate students conducting thesis research using these prepackaged computer programs but little opportunity exists to

practice the various steps required to prepare the data cards and control cards and then interpret the computer printout of the analysis. A minimum of two such assignments could be required (instead of the present one), with additional ones available but left to the discretion of the individual students.

Other suggestions

Other suggested changes in STAT1 consist mainly of housekeeping activities: increase the use of titles and headings in segments 13, 16 and 17, improve the second explanation of a principle where one is offered, close the gap between sample questions and test questions, and insert restart points at more frequent intervals in segments 4 and 25.

As it stands, STAT1 is acceptable to most students. The preceding suggestions are based on the perceptions of people who have had first hand experience trying to learn the bulk of the subject matter in EdPsy 502 via computer-assisted instruction. As such the suggestions are intended to improve the program for future use, although it is recognized that future students may have additional ideas for improving the program. Since the type of comments received tended to be fairly consistent across groups, one may be fairly certain that the changes requested are not the result of only a few dissatisfied students.

The Future of STAT1

The computer equipment which is currently used to provide computer-assisted instruction at the University of Alberta has been designated obsolete by its manufacturers and is scheduled for removal in 1980.

As provisions for replacement have not been finalized, there will likely be a period of time during which no CAI programs will be available at the university, including STAT1. Since STAT1 has shown itself to be a popular and reasonably efficient method for teaching statistics, one would hope that provision for reinstating this program will not be too long delayed.

Despite the inconclusiveness of much of the literature pertaining to attitude and achievement studies revolving around CAI, STAT1 has proven to be regarded positively by most students with the drawbacks being far outweighed by the advantages. Computer-assisted instruction is a viable alternative to classroom instruction and, while the results of this study are not intended to indicate that students prefer CAI over classroom instruction in all instances, they certainly suggest that students prefer to learn statistics via CAI.

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End of Segment Opinionaire (STAT1)

1. I found the material in this chapter was quite useful in helping me learn basic statistics.
2. The material in this chapter was quite boring.
3. I found this chapter easy to understand.
4. I previously had not been taught any of the material in this chapter.
5. There was never anyone available in the terminal room to help answer my questions about this chapter.
6. I feel that someone who is knowledgeable in the course content of this chapter should always be available in the terminal room.
7. Whenever there was a course content specialist available in the terminal room that person very often did not know the material very well.
8. I feel that it would have been easier for me to learn the material in this chapter by classroom instruction rather than by computer-assisted instruction.

APPENDICES

STAT1 OPINIONAIRE

Please answer the following questions about your perceptions of the STAT1 computer-assisted instruction program as it was used in Educational Psychology 502.

Indicate your response by placing an "X" in the a-propriate space.

---

1. In which session did you take Ed. Psych. 502 via computer?

   Winter 1976-77 _____ Spring 1977 _____
   Spring 1978 _____ Summer 1978 _____

2. At what point in your program did you take Ed. Psych. 502?

   1st year _____ 2nd year _____ Other (Explain) _____

3. Rate the importance of each factor in your decision to take Ed. Psych 502 when you did.

	Not Imp.						Very Imp.
a) computer-assisted instruction course	___	___	___	___	___	___	___
b) positive comments from other students	___	___	___	___	___	___	___
c) the instructors	___	___	___	___	___	___	___
d) concerned about going at my own speed	___	___	___	___	___	___	___
e) other (specify)	___	___	___	___	___	___	___

4. I was apprehensive about taking Ed. Psych 502.

Strongly Agree						Strongly Disagree
_____	_____	_____	_____	_____	_____	_____

5. My apprehension was based on

_____ dislike for mathematics

_____ uncertainty about taking a course via computer

_____ doubt about the usefulness of a statistics course

_____ other (please specify)

6. I found the STAT1 program was useful in helping me learn statistics.

Strongly Agree						Strongly Disagree
_____	_____	_____	_____	_____	_____	_____

7. It would have been easier to learn the STAT1 material by classroom instruction rather than by computer instruction.

Strongly Agree						Strongly Disagree
_____	_____	_____	_____	_____	_____	_____

8. The material in the program was:

Very Boring						Very Interesting
_____	_____	_____	_____	_____	_____	_____

9. Generally the content was easy to understand.

Strongly Agree						Strongly Disagree
_____	_____	_____	_____	_____	_____	_____

10. I would rate the difficulty level of STAT1 as being:

Very Easy						Very Difficult
_____	_____	_____	_____	_____	_____	_____

11. What portion of the material covered in STAT1 had you previously been taught?

None						All
_____	_____	_____	_____	_____	_____	_____

12. Is there anything which could be added to improve STAT1?

13. Are there any sections of STAT1 which could be dropped?

14. How helpful were the labs which accompanied STAT1?

Very Helpful						Not At All
_____	_____	_____	_____	_____	_____	_____

15. I would have preferred to have the research design component taught by computer rather than in seminar.

Strongly Agree						Strongly Disagree
_____	_____	_____	_____	_____	_____	_____

16. I would like to have had more seminar sessions scheduled.

Strongly Agree						Strongly Disagree
_____	_____	_____	_____	_____	_____	_____

17. It was useful to have the computer terminals available on Saturdays and Sundays.

Always						Never
_____	_____	_____	_____	_____	_____	_____

18. Someone who is knowledgeable of the STAT1 content should be available in the terminal room to answer questions.

Strongly Agree						Strongly Disagree
_____	_____	_____	_____	_____	_____	_____

19. I liked taking statistics via computer-assisted instruction.

Strongly Agree						Strongly Disagree
_____	_____	_____	_____	_____	_____	_____

20. Taking statistics via computer-assisted instruction was a good investment of my time.

Strongly Agree						Strongly Disagree
_____	_____	_____	_____	_____	_____	_____

21. I would recommend the STAT1 program to other graduate students or educational personnel.

Strongly Agree						Strongly Disagree
_____	_____	_____	_____	_____	_____	_____

22. What do you think were the major advantages of using the STAT1 program as part of Ed. Psych. 502?

23. What do you think were the major disadvantages of using the STAT1 program as part of Ed. Psych 502?

24. I would like to take other courses via computer-assisted instruction.

Strongly Agree						Strongly Disagree
_____	_____	_____	_____	_____	_____	_____

25. Have you taken other courses via computer-assisted instruction?

No _____ Yes _____ (Please give details)

26. Are there any subsections of the STAT1 program which have been particularly useful? Please list.

27. Which components learned in STAT1 have you used since you took the program?

28. How useful was (is) the material learned in Ed. Psych. 502 in doing your thesis?

Very Useful						Not At All
_____	_____	_____	_____	_____	_____	_____

29. In doing my thesis I used (am using) the material learned in Ed. Psych. 502 in:

a) an active role, i.e., to calculate statistics

Very Much						Not At All
_____	_____	_____	_____	_____	_____	_____

b) a passive role, i.e., to read journals and critique the work of others, to advise others

Very Much						Not At All
_____	_____	_____	_____	_____	_____	_____

30. How useful was (is) the material learned in Ed. Psych. 502 in your general work situation?

Very Useful						Not At All
_____	_____	_____	_____	_____	_____	_____

31. In my general work situation I use the material learned in Ed. Psych. 502 in:

a) an active role

Very Much						Not At All
_____	_____	_____	_____	_____	_____	_____

b) a passive role

Very Much						Not At All
_____	_____	_____	_____	_____	_____	_____

January 3, 1979

Dear

As you are probably aware, Ed. Psy. 502 (statistics) has been offered via computer-assisted instruction for several years now. Although the program seems to work well and students offer positive feedback, follow-up evaluation of a formal nature is needed to determine program effectiveness over time.

Therefore, course graduates like yourself are being asked to donate 30 to 45 minutes to aid in this evaluation by completing 1) an opinionaire much like the one you filled out at the end of the course, and 2) an achievement questionnaire which samples the course material. Copies are enclosed.

Please answer the opinionaire first. It will take only 2 or 3 minutes to complete. Then answer the 15 item achievement questionnaire which should take about 30 minutes. Please do not spend more than 45 minutes on it. You may do it as an open book exam but work independently. The results will not identify you as an individual, nor will they be used for any purpose other than this evaluation.

Please return the questionnaires in the envelope provided, by January 22, 1979. If you have any questions, please feel free to contact me through the Ed. Psych. Dept. at the university.

Thank you for your time and cooperation.

Yours truly,

Fran Vargo
Graduate Student